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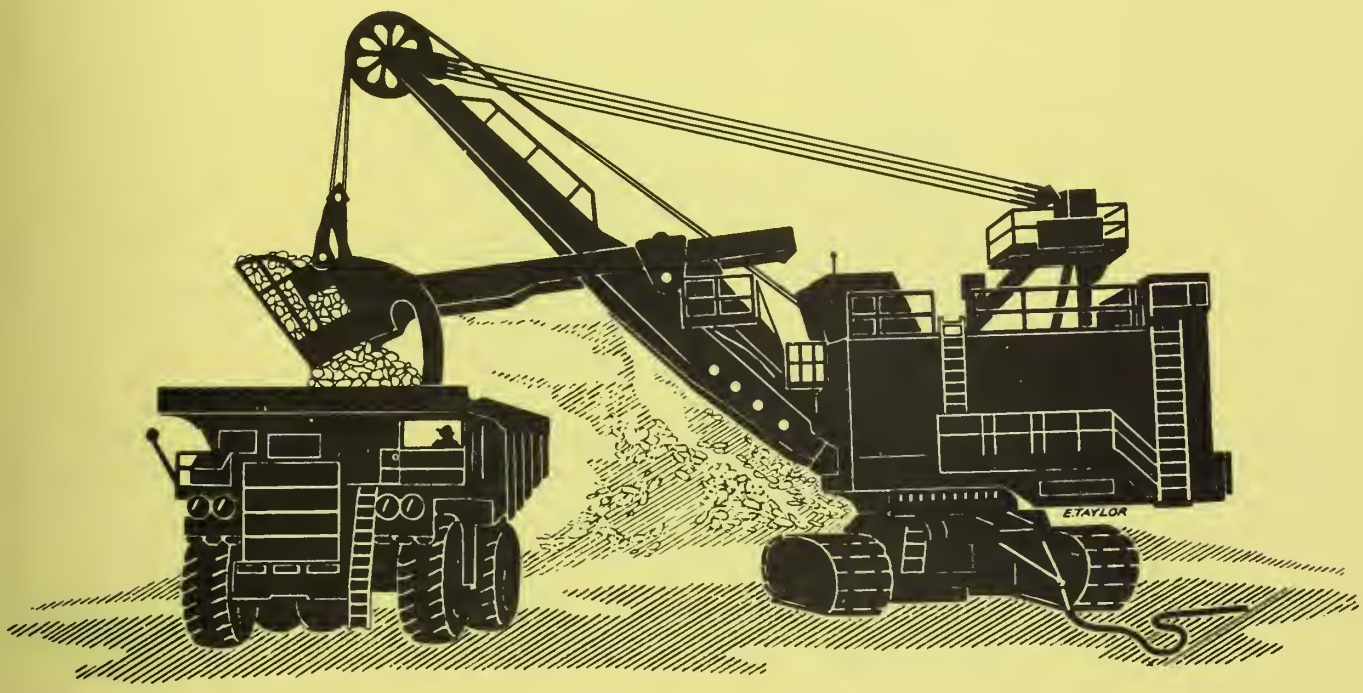
MINERAL COMMODITY REPORT

— ANHYDROUS AMMONIA (NITROGEN) ——

1985



CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY

SPECIAL PUBLICATION 79

STATE OF CALIFORNIA
GEORGE DEUKMEJIAN
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THE GREAT SEAL OF THE STATE OF
EUREKA
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MINERAL COMMODITY REPORT

-- ANHYDROUS AMMONIA (NITROGEN) --

1985

By
GARY TAYLOR

Part I compiled from
the U.S. Bureau of Mines'
Minerals Yearbooks, 1980-84.

CALIFORNIA DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
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INTRODUCTION

This report on the availability and demand for nitrogen in California, the United States, and the world is one of a series of Mineral Commodity Reports prepared by the California Division of Mines and Geology (CDMG) to describe commodities of significance to California and the nation.

The first section in this report consists of United States and world-wide mineral-statistic information adapted directly from the U.S. Bureau of Mines "Mineral Commodity Summaries" (1984). The second section, prepared by the California Division of Mines and Geology, discusses production of the commodity in California. The U.S. Bureau of Mines presents the earliest Government estimates of non-fuel mineral-industry data, including world resource data provided by the U.S. Geological Survey. This report was compiled by Gary C. Taylor of the CDMG geologic staff. For further information please call (916) 445-5716, the CDMG centralized information number.

Nitrogen is an essential fertilizer element which has no substitute. Approximately 80 percent of the 15 million tons of ammonia that was produced in the United States was utilized as fertilizer, with the remaining 20 percent used to produce plastics, resins, explosives and other chemicals.

All U.S. and California production of anhydrous ammonia is synthesized from hydrogen and atmospheric nitrogen at high temperature and pressure in the presence of a suitable catalyst, as no commercial deposits of natural nitrogen compounds have been found in California. In 1983, California produced 345,000 tons of anhydrous ammonia (less than 2-1/2 percent of the total U.S. production) from three plants located in southern California.

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1. UNITED STATES PRODUCTION AND USE

The average f.o.b. value of ammonia produced in the United States in 1983 was estimated to be $2.4 billion. Ammonia was produced by 57 plants owned by 45 firms, primarily by the steam reformation of natural gas. With few exceptions, ammonia manufacture is totally dependent on expensive fossil fuels. Approximately 80% of the ammonia produced was used as fertilizers that include anhydrous ammonia, urea, ammonium phosphate, ammonium nitrate, and other nitrogen compounds. Ammonia also was used to produce plastics, fibers, and resins, 10%; explosives, 4%; and numerous other chemicals, 6%.

2. SALIENT STATISTICS--UNITED STATES

Ammonia (Data in thousand short tons of nitrogen)

	1979	1980	1981	1982	1983	1984 e
Production	15,420	16,244	15,619	12,742	11,275	15,000
Imports for consumption	1,603	1,921	1,719	1,737	1,800	
Exports	649	681	506	610	450	
Apparent consumption	16,666	17,753	16,355	13,859	12,920	
Producer stocks, yearend	1,752	1,483	1,960	1,970	1,900	
Quoted price, dollars per short ton, ammonia, yearend f.o.b. gulf coast[1]	128-132	120-125	132	120	155	
Employment	4,137	4,500	4,000	3,000	3,000	
Net import reliance[2] as a percent of apparent consumption	7	8	5	8	11	

3. RECYCLING

None.

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e Estimated. Frank Maxiey, Department of Commerce

1 Source: Green Markets.

2 Defined as imports - exports + adjustments for Government and industry stock changes.

Prepared by C. L. Davis, telephone number (202) 634-1190.

4. IMPORT SOURCES (1979-82)

Ammonia: Canada 27%, Trinidad and Tobago 22%, U.S.S.R. 22%, Mexico 21%, Other 8%.

5. TARIFF

Item	Number	Most Favored Nation (MFN) 1/1/84	Most Favored Nation (MFN) 1/1/87	Non-MFN 1/1/84
Ammonia, fertilizer	480.6540	FREE	FREE	FREE
Ammonia, chemical	417,220	4.3% ad val.	2.8% ad val.	28% ad val.

6. DEPLETION ALLOWANCE

Not applicable.

7. GOVERNMENT STOCKPILE

None.

8. EVENTS, TRENDS, AND ISSUES

Nitrogen (Fixed)--Ammonia: Nitrogen fertilizer manufacture is the most capital and energy intensive branch of the chemical fertilizer industry. This fact has inhibited capacity expansions and motivated importation of ammonia from sources with low-cost natural gas feedstock. U.S. ammonia producers operated below capacity in 1983 because of a reduction in acreage under cultivation, which reduced fertilizer demand. Natural gas price deregulation, foreign competition, and the increased costs of renegotiated natural gas contracts forced some plants to close or become idle, reducing U.S. ammonia capacity by more than 5 million tons. Prices of ammonia fell in 1983 to a yearly low of $115 per ton f.o.b. gulf coast, compared with a low of $112 in 1982. The highest f.o.b. gulf coast ammonia price for 1983 was $163, compared with $162 in 1982. From a 1981 base, demand for ammonia is expected to increase at an annual rate of about 1.3% through 1990. It is estimated that in 1984 domestic production of ammonia will be 14 million tons and U.S. apparent consumption will be 16 million tons.

The Natural Gas Policy Act of 1978 contains a decontrol provision based on a system of incremental price increases until 1985, when price controls on much of the natural gas are scheduled to be lifted. The act provides that essential agricultural uses of natural gas, including ammonia production, will receive priority second only to residential, school, and hospital use in the event of curtailments.

9. WORLD PRODUCTION AND RESERVE BASE

	Ammonia Plant Production		Reserve Base*
	1982	1983e	
United States	12,742	11,500	Large
Canada	2,766	2,800	"
France	2,205	2,200	"
Germany, Federal Republic of	2,205	2,200	"
India	4,023	4,200	"
Italy	1,323	1,300	"
Japan	1,841	1,800	"
Mexico	2,183	2,200	"
Netherlands	2,094	2,100	"
United Kingdom	1,962	2,000	"
Other Market Economy Countries	12,338	12,400	"
Centrally Planned Economies	34,396	34,500	
World Total	80,078	79,200	

10. WORLD RESOURCES

The availability of nitrogen from the atmosphere for fixed nitrogen production is unlimited. Hydrogen required for ammonia production is most commonly obtained from natural gas and by gasification of solid and liquid fuels. Natural gas is widely used to manufacture ammonia because of the comparable favorable costs with solid or liquid fuels. Natural nitrogen compounds occur in the Atacama desert of Chile, where there are an estimated 2.5 billion tons of ore above a cutoff of 7% sodium nitrate. The balance of the Atacama Desert resource may be as large as 25 billion tons.

11. SUBSTITUTES

Nitrogen is an essential fertilizer element which has no substitute. There are no economic substitutes for fixed nitrogan explosives and blasting agents in conventional uses. Specific substitutes are available for plastics, fibers, and synthetics but with changes in product characteristics.

* Pending establishment of criteria for the reserve base, classification of data is based on a judgmental appraisal of current knowledge and assumptions.

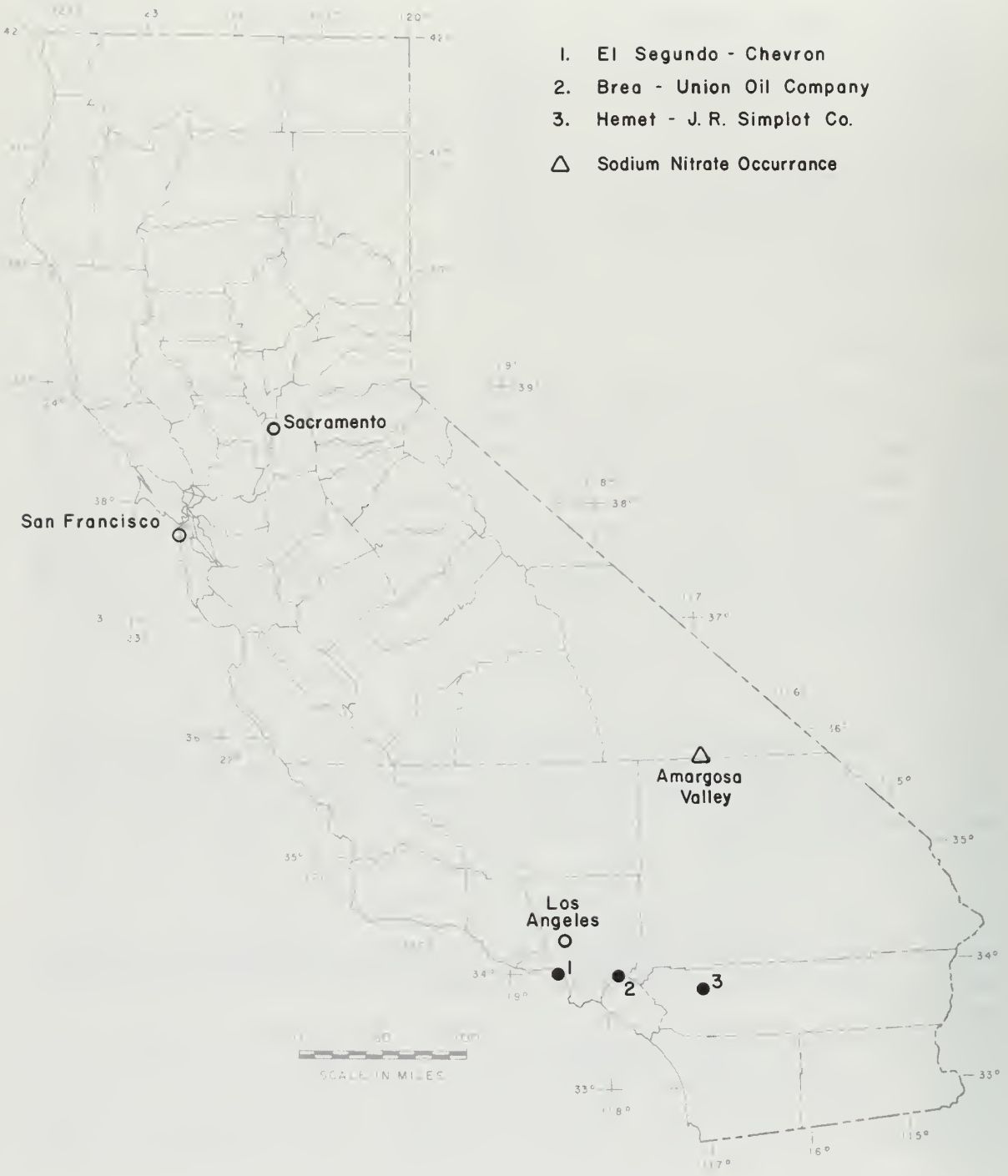

Figure 1. Locations of California anhydrous ammonia (nitrogen) producers

PART II: CALIFORNIA

12. CALIFORNIA GEOLOGICAL OCCURRENCES

Although nitrogen is a comparatively abundant element, much of it exists in the atmosphere (78 percent by volume) as a nearly inert gas that can be combined with other elements only with difficulty. Prior to the production of anhydrous ammonia synthesized from hydrogen and atmospheric nitrogen, natural deposits of nitrogen minerals were utilized. The largest natural deposits of nitrates in Chile were a major world supplier of sodium nitrate ($NaNO_3$) until the 1960's. The ready availability of natural gas feedstocks in the 1960's led to the demise of the Chilean nitrate industry, as the steam reformation of anhydrous ammonia from natural gas became technically and economically feasible.

No commercial deposits of natural nitrogen compounds have been found in California, although traces of sodium nitrate have been found in certain playas and in efflorescent deposits throughout the southeastern desert. An exhaustive search of these occurrences was undertaken by the United States Geological Survey during and following World War I. The most promising deposits were in the southern part of the Amargosa Valley, Inyo and San Bernardino Counties, where two areas totaling 168 acres were estimated to contain 1,980 tons of sodium nitrate. The nitrate occurs with sodium chloride and other salts in a layer of caliche about 5 inches thick that rests on folded Tertiary lake beds. The caliche is unevenly distributed and averages less than 2.5 percent sodium nitrate (Noble, 1922, p. 91).

13. CALIFORNIA LOCALITIES

Currently the most important nitrogen compound in California is synthetic anhydrous ammonia produced at three plants in southern California (Figure 1). Ammonia is synthesized from hydrogen and atmospheric nitrogen at high temperature and pressure in the presence of a suitable catalyst by Union Oil at its Brea plant, J.R. Simplot Company at Hemet and Chevron Chemical Company at its El Segundo plant. A minor amount of nitrogen gas is recovered from gas field operations near Robbins.

14. CALIFORNIA PRODUCTION

Production of anhydrous ammonia in California contributes less than 2 1/2 percent to the nationwide total of 15,000,000 tons produced in 1983. According to the California Department of Food and Agriculture, approximately 345,000 tons of anhydrous ammonia was produced in California in 1983.

15. UTILIZATION AND MARKETS

Nitrogen compounds are of economic value because nitrogen is a plant food that is essential for the healthy growth of plants, and because nitric acid is an important chemical raw material used in the manufacture of explosives, plastics and synthetic fibers and in pulp processing.

California soils are in general more deficient in nitrogen than in other plant foods. In addition to the nitrogen removed by crops, nitrates are leached from soils, and the gaseous nitrogen released by bacterial action also is lost. It is thought that nitrogen must be in the form of nitrate to be available to plants. The nitrogen content of manure and other organic compounds as well as that of ammonium salts and calcium cyanamide is, however, readily converted to the nitrate form in the soil by bacterial action. In California most of the nitrogen added to soils is in mixed fertilizers, but large tonnages of ammonia, ammonium sulfate, ammonium nitrate, ammonium phosphate, sodium nitrate, calcium nitrate, and calcium cyanamide also are used. In 1983, the fertilizer used by California agriculture contained 2,0003,197 tons of nitrogen and non-farm use totaled 119,620 tons of nitrogen (Department of Food and Agriculture, 1983).

16. MINING METHODS AND BENEFICATION

The production of nitrogen compounds in California is completely dependent upon the production of synthetic ammonia from synthesis gas produced by the steam-methane reformation process.

17. CALIFORNIA EVENTS, TRENDS, AND ISSUES

California's anhydrous ammonia producers are affected by the issues discussed in section 8 relative to the United States as a whole. Nitrogen fertilizer manufacture is the most capital and energy intensive branch of the chemical fertilizer industry. Natural gas deregulation, with resultant price increases for natural gas, reduced fertilizer demand, competition from low cost imports, and obsolete equipment with resultant plant inefficiencies caused two California producers (Valley Nitrogen and Duval) to become idle since 1982. Although California agriculture utilizes in excess of two million tons of nitrogen based fertilizer annually, the above economic considerations probably preclude any increase in plant capacity or new facilities to increase market share within California.

18. REFERENCES

California Department of Food and Agriculture, 1983, Fertilizing materials tonnage report for October-November-December, 1983.

Noble, L.F., and others, 1922, Nitrate deposits in the Amargosa region, southeastern California: U.S. Geological Survey Bulletin 724, 99 p.

Noble, L.F., 1931, Nitrate deposits in southeastern California, with notes on deposits in southeastern Arizona and southwestern New Mexico: U.S. Geological Survey Bulletin 820, 108 p.

U.S. Bureau of Mines, 1982, Nitrogen: Minerals Yearbook, v. 1, p. 635-642.

U.S. Bureau of Mines, 1984, Nitrogen (fixed) - Ammonia, in Mineral commodity summaries, 1983, p. 108-109.

Ver Planck, W.E., 1955, Minerals of commercial fertilizers, in Minerals useful to California Agriculture, California Division of Mines and Geology, Bulletin 155, p. 73-77.

Ver Planck, W.E., 1957, Nitrogen Compounds, in Mineral Commodities of California: California Division of Mines and Geology, Bulletin 176.

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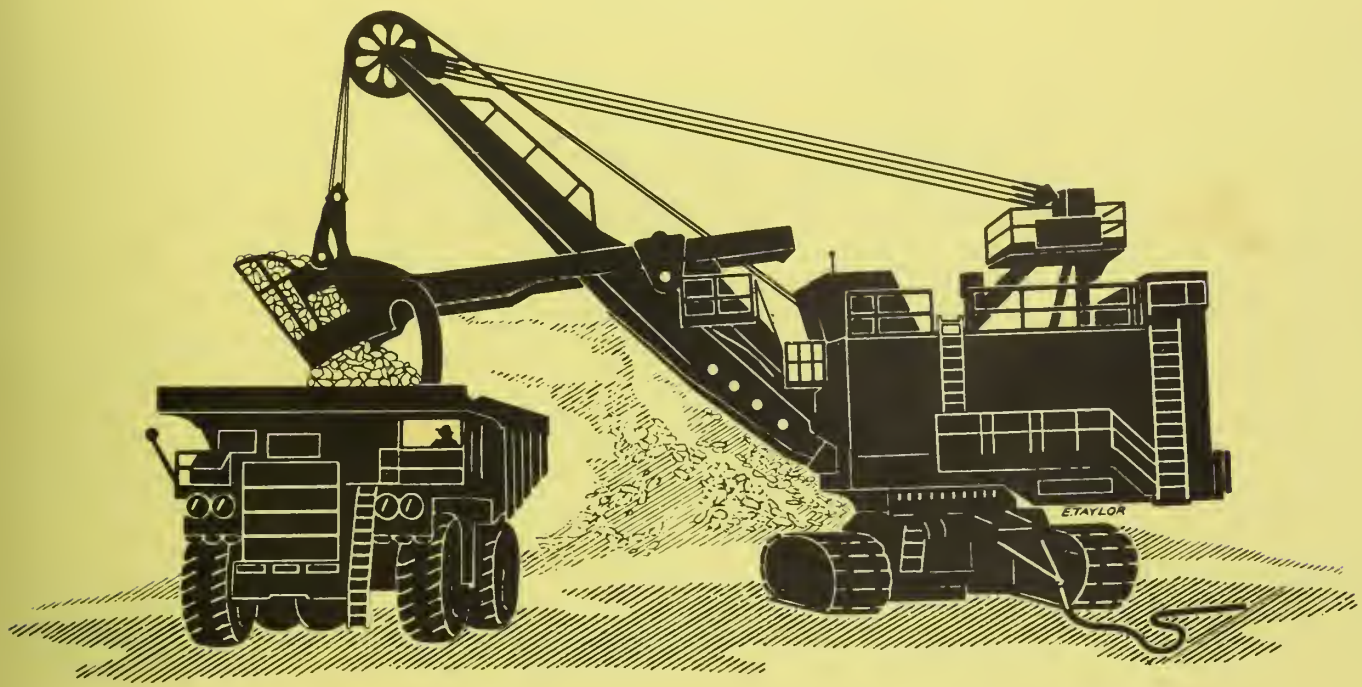

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